

JEWELRY LINK FORMING APPARATUS

RELATED APPLICATIONS

This application is based in part upon Provisional
5 Application No. 60/379,162, filed May 8, 2002, which is
incorporated by reference herein and upon application serial
number 10/314,211, filed December 9, 2002.

FIELD OF THE INVENTION

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The present invention relates to optimal width jewelry links
For jewelry pieces, such as necklaces and the like.

BACKGROUND OF THE INVENTION

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In the jewelry industry the fabrication of chains, including
rope chains, from individual C-shaped wire links is well known.
The process is either manual or machine automated. The available
technology can automatically form the wire links from a
20 continuous supply of wire of a variety of crosssectional shapes,
such as round, square, or triangular.

However, the wire is bent around a mandrel and further
formed with dies such that, except for round crosssection wire,
the C-shaped links always have a flat side that wraps around the
25 mandrel, thus forming the inside diameter of a link to be formed
from the wire.

This limits the width of the wire to the diameter of the cylindrical wire, or to the width of one edge of a square wire.

OBJECTS OF THE INVENTION

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It is therefore a desirable object of the present invention to be able to form C-shaped jewelry links, from square crosssectional wire, with a diamond shaped geometry, wherein an edge of the wire is wrapped around the mandrel, thus forming a C-
10 shaped link whereby two distinct facet surfaces are visible from a top view.

Other objects which become apparent from the following description of the present invention.

15 SUMMARY OF THE INVENTION

In keeping with these objects and others, which may become apparent, the present invention includes machinery and a method for producing a wide C-shaped jewelry link, as well as the C-
20 shaped link product produced thereby.

The crosssection of the link-forming wire, which is orthogonal to the plane of the link, is then diamond shaped, with the widest points of the link corresponding to the wide common hypotenuse joining the two equilateral triangles, which forms the diamond
25 crosssectional width of the C-shaped link.

Thus the C-shaped links of the present invention appear to

have been formed from a wire material having a width, which is 41% wider, than one wrapped from the same wire, using a flat surface against the forming mandrel. The C-shaped links thus formed also have two reflecting surfaces, when viewed from a top view.

To achieve this result, both the mandrel as well as the forming dies are grooved, in order to hold the square wire on one of its edges, during the wrapping and forming operations.

In an alternative embodiment, the mandrel is smooth. The tip of the rotated square wire is held by the groove in the forming die from above. As the wire is wrapped around the mandrel, the die from below is also grooved.

Although not absolutely essential, an optional spring-mounted mandrel is used to automatically pop off the finished C-shaped link from its alignment groove, prior to removal for further automated or manual assembly into the desired chain.

Many methods for dealing with the gap at the distal ends of a C-shaped link, as for prior art chains are applicable. One technique involves bonding two links together in pairs after they have engaged the desired number of other double link pairs.

Therefore, the present invention includes a method and a machine for forming a wide C-shaped link from a square wire having corners, forming a diamond shape when viewed in cross section, for use in making a jewelry chain. The machine includes a means for feeding the wire in and along a V-shaped groove formed in a surface of a stationary die, wherein the V-shaped

groove is adapted to accommodate a first corner of the wire. The machine also includes a cutter for cutting the wire, to form a discrete wire section, with a predetermined length of the wire in the V-shaped groove, wherein the surface of the die has a concave forming surface between ends of the predetermined length of the wire.

The concave forming surface has a shape including a corner to correspond with the first corner of the wire in the V-shaped groove. In one embodiment, a mandrel has a guidance groove matching a second corner of the wire, on an opposite side of the wire from the first corner, for pushing and bending the wire into the concave forming surface to form the wire into a U-shaped configuration. A pair of movable die sections close the wire, to form a C-shaped link surrounding the mandrel and the movable die sections have die V-shaped grooved surfaces, which are shaped to correspond to the first corner of the wire, thereby forming a C-shaped link of the wire, in which the second corner forms an inner circumference of the C-shaped link and the first corner forms an outer circumference of the C-shaped link.

The wire is square in cross section so that the C-shaped link is diamond-shaped, with optional facets, when viewed in cross section.

The wire may be a polygon, when viewed in cross section so that said C-shaped link is diamond shaped with facets.

The machine also includes an optional apparatus for removing a C-shaped link from a mandrel circular in cross section, the C-

shaped link being in a groove surrounding the mandrel. This optional apparatus has a mandrel housing, having a blind hole in an end wall, to receive one end of the mandrel. This blind hole has a diameter, which is large enough to receive a first end of the mandrel, and which is not large enough to accommodate the C-shaped link on the mandrel. A pin is provided at right angles to a length of the mandrel for contacting an end of the mandrel within the hole, when the mandrel is inserted into the hole. A spring is provided within the hole, and it contacts a side of the pin, which is opposite to a side in contact with the first end of the mandrel. An anvil forces the first end of the mandrel against the pin compressing the spring, causing the end wall of the mandrel housing to pop the C-shaped link out of the groove in the mandrel. The spring at least partially ejects the mandrel from the blind hole when the anvil is retracted away from the mandrel.

A gripper mechanism is provided to remove the C-shaped link from a second end of the mandrel, after the C-shaped link is removed from the groove in the mandrel.

A length extending from the groove to the second end of the mandrel is sufficiently short as to allow the C-shaped link, when popped out of the groove in the mandrel, to drop into a container for collecting the C-shaped link.

In operation, a method is provided of making a jewelry chain from C-shaped links formed from a wire having corners in cross section, wherein the method comprises the steps of:

a) feeding the wire in and along a V-shaped groove formed in a surface of a stationary die, the V-shaped groove being adapted to accommodate a first corner of the wire;

b) cutting the wire to form a predetermined length of the wire in the V-shaped groove, the surface of the die having a concave forming surface between ends of the predetermined length of the wire, the concave forming surface having a shape, including a corner, to correspond with the first corner of the wire in the V-shaped groove;

c) pushing and bending the wire into the concave forming surface, using a mandrel, optionally or not having a guidance groove matching a second corner of the wire, on an opposite side of the wire from the first corner, to form the wire into a preliminary U-shaped configuration;

d) closing the wire to form a C-shaped link surrounding the mandrel, using a pair of movable die sections, the movable die sections having die V-shaped grooved surfaces, which are shaped to correspond to the first corner of the wire, thereby forming a C-shaped link of the wire, in which the second corner forms an inner circumference of the C-shaped link and the first corner forms an outer circumference of the C-shaped link;

e) removing the C-shaped link from the mandrel;

f) moving successive wire segments along the V-shaped groove formed in the surface of the stationary die to produce a plurality of C-shaped links from the same wire; and

g) combining the C-shaped links to form a jewelry chain.

The operation also includes a method of removing a C-shaped link from a mandrel, which is circular in cross section, wherein the C-shaped link surrounds the mandrel, which removal operation includes the steps of:

- 5 a) inserting one end of the mandrel into a hole in an end wall of a mandrel housing, the hole having a diameter large enough to receive the mandrel and not large enough to accommodate the C-shaped link on the mandrel, wherein a pin is within the hole at right angles to a length of the mandrel for contacting an
10 end of the mandrel within the hole, when the mandrel is inserted into the hole, and a spring is within the hole contacting a side of the pin opposite to a side in contact with the mandrel;
- b) using an anvil to push the mandrel against the pin, compressing the spring and causing the end wall of the mandrel
15 housing to pop the C-shaped link out of the groove in the mandrel, wherein the spring at least partially ejects the mandrel from the hole when the anvil is retracted; and
- c) removing the C-shaped link from one end of the mandrel.

The method of the operation also includes removing the C-
20 shaped link from the mandrel, by using a gripper, to grab the C-shaped link and moving the C-shaped link past an end of the mandrel.

Finally, the C-shaped link is removed from the mandrel by dropping off one end of the mandrel when the C-shaped link is
25 popped out of the groove, which results in a fine jewelry link having a wide diamond-shaped crosssection, without the need for

expensive grinding or embossing to form the diamond-shaped configuration of the crossection of the formed C-shaped link.

BRIEF DESCRIPTION OF THE DRAWINGS

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The present invention can best be understood in connection with the accompanying drawings. It is noted that the invention is not limited to the precise embodiments shown in drawings, in which:

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Fig. 1 is an End view of the wire cutting phase in the jewelry link forming process;

Fig. 1A is an End view of an alternate embodiment for the wire cutting phase in the jewelry link forming process; wherein the mandrel is smooth;

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Fig. 2 is a Crossectional view showing the holding groove as in Figure 1, along a bottom of fixed die as well as a mandrel groove;

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Fig. 2A is a Crossectional view showing the alternate embodiment for the holding groove as in Figure 1A, along bottom of fixed die as well as a mandrel without a groove;

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Fig. 3 is a Crossectional view showing the internal groove

in a fixed forming die used with the grooved mandrel of Figures 1 and 2;

Fig. 3A is a Crossectional view showing an alternate
5 embodiment for the internal groove in a fixed forming die used with the smooth mandrel of Figures 1A and 2A;

Fig. 4 is an End view showing a preliminary U-shaped
partially formed C-shaped link, just prior to forming into a
10 final C-shaped link, by movable dies, as in Figures 1, 2 and 3;

Fig. 4A is an End view showing the alternate embodiment for
a preliminary U-shaped partially formed C-shaped link, just prior
to forming into a final C-shaped link, by movable dies, as in
15 Figures 1A, 2A and 3A;

Fig. 5 is an End view of the C-shaped link of Figures 1, 2,
3 and 4 wrapped around a mandrel after forming;

20 Fig. 5A is an End view of the alternate embodiment for the C-shaped link as in Figures 1A, 2A, 3A and 4A wrapped around a mandrel after forming;

Fig. 6 is a Side elevational view of the C-shaped link
25 formed by either embodiment of Figures 1 or 1A, shown on the forming mandrel prior to a strike by an anvil;

Fig. 7 is a Side elevational view of the moved C-shaped link on the mandrel, at the end of the strike by the anvil;

5 Fig. 8 is a Side elevational view of the C-shaped link on the mandrel, after withdrawal of the anvil, with subsequent movement of the gripper, wherein the moved gripper and link are shown in phantom lines;

10 Fig. 9 is a Top plan view of two diamond crossection C-shaped links of this invention bonded as a pair;

Fig. 10 is a Side elevational view detail of a section of an assembled rope chain using diamond crossection C-shaped links of
15 this invention;

Fig. 10A is a Crossectional detail view of a link formed from square wire, as in Figure 10;

20 Figure 11 is a crossectional view of a wire of an alternate embodiment with vertical flat facets;

Figure 12 is a crossectional view of a wire of a further alternate embodiment with both horizontal and vertical flat
25 facets;

Figure 13 is a crosssectional view of a wire of yet another alternate embodiment with horizontal flat facets;

Figure 14 is a crosssectional view showing the internal
5 groove in the fixed forming die grasping a wire of an alternate embodiment (similar to Figure 3); and,

Figure 15 is a close-up detail view of a portion of Figure 14 showing the wire crosssection.

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DETAILED DESCRIPTION OF THE INVENTION

This invention describes the detailed modifications of the forming mechanism required to produce C-shaped links, having a
15 diamond-shaped crosssection, from square wire. The modified forming mechanisms are then integrated into prior art machinery to produce the C-shaped links of this invention and optionally to use these C-shaped links, to form linear or rope chain in an automated process.

20 Figure 1 shows the cutting phase of wire 4. Prior to cutting, wire 4, in the proper crosssectional orientation, is pushed to the right guided by V-shaped groove 6 along the bottom edge of fixed die 1 and between the gap above mandrel 2 with guidance V-shaped groove 7. Wire 4 is advanced until stopped by
25 the side frame member 3. Then cutter 5 is cycled upward to cut wire 4 into a discrete section.

Inside contour 8 of fixed forming die 1 can be better understood by the crossection views of Figures 2 and 3. The depth of mandrel groove 7 is exaggerated for clarity.

Figure 4 is an end view showing the phase of c-link formation after mandrel 2 is moved upward into the recess of fixed die 1, thereby forming the length of wire 4 into the U-shape shown.

At this point, cam mechanisms (not shown) move movable die 15, with sections 16 and 17, upward and sideways, to close the ends of the U-shape link into finished C-shaped link 40, as shown in Figure 5.

Movable die sections 16 and 17 have grooved recesses 18 to support wire 4 in the proper orientation. C-shaped link 40 has gap 25 and outer edge 24, which is a vertex of the diamond crossection.

Figure 1A shows an alternate embodiment for the cutting phase of wire 104. Prior to cutting, wire 104, in the proper crossectional orientation, is pushed to the right guided by V-shaped groove 106 along the bottom edge of fixed die 101 and between the gap above smooth mandrel 102. Wire 104 is advanced until stopped by the side frame member 103. Then cutter 105 is cycled upward to cut wire 104 into a discrete section.

Inside contour 108 of fixed forming die 101 can be better understood by the crossection views of Figures 2A and 3A.

Figure 4A is an end view showing the phase of c-link formation after mandrel 102 is moved upward into the recess of

fixed die 101, thereby forming the length of wire 104 into the U-shape shown.

At this point, cam mechanisms (not shown) move movable die 115, with sections 116 and 117, upward and sideways, to close the
5 ends of the U-shape link into finished C-shaped link 140, as shown in Figure 5A.

Movable die sections 116 and 117 have grooved recesses 118 to support wire 104 in the proper orientation. C-shaped link 140 has gap 125 and outer edge 124, which is a vertex of the diamond
10 crosssection.

Figures 6, 7 and 8 are a sequence of side views which show further automated steps in the process after C-shaped links 40 or 140 are formed. Alternate embodiments with mechanisms not using a retractable mandrel as shown in Figures 6, 7 and 8 are also
15 possible, if a very shallow V-shaped groove 7 is used to guide wire 4 during forming. Mandrel housing 31 has a blind end hole 32 which houses spring 33, forcing a retractable mandrel 2 out to its normal position as set by pin 35, riding in slot 36. Anvil 30 with recess 34 can be moved laterally, from the resting
20 position of Figure 6, to its full impact position of Figure 7. The impact dislodges C-shaped link 40 from groove 7 on mandrel 2 and simultaneously flattens C-shaped link 40 against the flat end faces of housing 31 and anvil 30 to remove any inadvertent twisting.

25 After anvil 30 is withdrawn as shown in Figure 8, C-shaped link 40 has been moved closer to the end of mandrel 2 and gripper

38 (with articulated arms or spring actuated arms as shown) is descending, to engage C-shaped link 40, with grooved end 39, to continue an automated fabrication process, by removing C-shaped link 40 from the end of mandrel 2. The moved gripper 38 and C-shaped link 40 is shown in phantom lines in Figure 8.

In an alternate system to just form C-shaped links 40 for manual fabrication, or to feed in bulk to a separate automated machine, C-shaped links 40 can be simply ejected into a bin, after the step of Figure 8, by a slight modification of anvil 30. Instead of recess 34, a short rounded protrusion from the end face of anvil 30 is used. This protrusion will move mandrel 2 farther into housing 31, thereby dislodging C-shaped link 40 from the end of mandrel 2, at the impact step shown in Figure 7. C-shaped link 40 then just falls into a receiving bin when modified mandrel 30 is withdrawn.

Many different types of chains can be made with C-shaped links 40. While gap 25 of C-shaped link 40 permits one link to engage another, different methods are used to deny the unlinking, such as by squeezing each C-shaped link 40 to reduce gap 25. Also, although depicted as having a large inner diameter relative to the circumference, a wide variety of cross-section width to link diameters are possible as desired. One locking technique involves the bonding of C-shaped links 40 in pairs after the desired number of other C-shaped link pairs have been engaged.

Figure 9 illustrates this method whereby two C-shaped links 40 are overlapped as shown and then bonded at edges 50 by any of

a variety of techniques such as soldering, welding, brazing, or adhesive.

Figure 10 shows a section of rope chain 55 formed with C-shaped links 40. Figure 10a is a close-up detail view of the
5 diamond crossection of C-shaped link 40.

Figures 11, 12 and 13 show three crossections of an alternate embodiment of a wire with two or four facets oriented into a diamond configuration, to be used in making the C-shaped links of this invention.

10 For example, the crossection of wire 60 in Figure 11 is formed by truncating two horizontal vertices of a wire having a diamond shape crossection, to form two vertical flat facets 62. Truncating can be done by shaving off the corners of wire 60 (as in Figure 11), wire 67 (as in Figure 12) or wire 69 (as in Figure
15 13) before being bent.

The crossection of wire 67 in Figure 12 has both horizontal facets 63 as well as vertical 62 facets.

The crossection of wire 69 in Figure 13 has two horizontal facets 63. The crossections of wire 60 and wire 69 differ only
20 by orientation.

All three of these shapes for wires 60, 67 and 69 fit within the respective original circumscribing diamond shaped outlines 65. Other crossectional shapes that abide by the latter restriction, such as having one to four facets or even grooves
25 (not shown), replacing corresponding vertices of a diamond shaped wire, can be formed into C-shaped links, by the apparatus shown

in the previous drawings, without modification, as long as the die grooves are sized to accept wire having a diamond crosssectional shape, of a size corresponding to the circumscribing diamond shape.

5 Figures 14 and 15 show how a crosssection of wire 67 with four facets fits into, and is grasped by, inside contour 8 of fixed die 1 and groove 7 of mandrel 2. Figure 15 is a close-up enlarged detail view of the area indicated by the Phantom ellipse "A" of Figure 14.

10 For some crosssections of wires, such as wire 60 and wire 69, orientation of the wire is very important to obtain the bending direction desired. A 90-degree rotation of wire 60 of Figure 11 yields wire 69 of Figure 13, for example, for the purpose of forming C-shaped links.

15 It is further noted that the methods and apparatus shown in Figures 6-13 for forming jewelry link 40 of Figures 1, 2, 3, 4 and 5 and are also applicable for forming jewelry link 140 of Figures 1A, 2A, 3A, 4A and 5A.

20 In the foregoing description, certain terms and visual depictions are used to illustrate the preferred embodiment. However, no unnecessary limitations are to be construed by the terms used or illustrations depicted, beyond what is shown in the prior art, since the terms and illustrations are exemplary only, and are not meant to limit the scope of the present invention.

25 It is further known that other modifications may be made to the present invention, without departing the scope of the

invention, as noted in the appended Claims.